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Bisphenol- A: Use In Europe And Alleged Health Impacts.

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Bisphenol A (BPA) is called 4,4'-dihydroxy-2,2-diphenylpropane, its chemical formula is $C_{15}H_{16}O_2$, and molar mass (M) = 228.29 g/mole. BPA is a substance used in the manufacture of polycarbonate resins. According to researchers, a small amount of BPA can affect consumers and children. The small levels of BPA are enough to alter the reproductive and brain development. And these changes may contribute to the increased risk of prostate-related diseases, breast cancer, ovarian cysts, endometritis, and early puberty. Additionally, using BPA in the normal life can lead to negative impacts on the environment such as changing the evaporation rate and the rate of vaporization.

The aims of this thesis were to outline all the health impact of Bisphenol-A to human being as well as the environment effects of BPA. In addition to this, this thesis also gave the overview of the reactions of governments across the globe and in the European Union about affection of Bisphenol-A. By that, the governments and associations could release the solutions that can hamper the use of BPA.

Keywords	Bisphenol A, 4,4'-dihydroxy-2,2-diphenylpropane, $C_{15}H_{16}O_2$

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List of abbreviations

BPA	Bisphenol-A
PC	Polycarbonate
NTP	U.S. National Toxicology Program
FDA	The Food and Drug Administration
ECHA	European Chemical Agency
SML	Security Market Line
PCOS	Polycystic Ovary Syndrome
NHANES	National Health and Nutrition Examination Survey
ANSES	French Agency for Food, Environmental and Occupational Health & Safety
EFSA	European Food Safety Authority
GC-MS	Gas Chromatography Mass Spectrometry

1 Introduction

Bisphenol- A is a chemical compound which is used by manufactures to make plastic products for easy storage of food and water. The products made of BPA offers and easy way to manage freshness of edibles. It is used by almost all people across the globe regardless of its harmful effects. There has been continuous change in the management of BPA because the usage of products made with this material has impacted the health of many individuals *(Hassan, 2012)*. Issues linked with this material cause various health problems such as hormonal dis-balance, reproductive problems and asthma.

Bisphenol- A including its launch in 1891 came to modern use after its non-breakable property was discovered, and enabled in the production of, for example, canned food jars and packets, baby bottles for infants and universal water bottles. This thesis outlines the health and environmental problems which arise because of over use of products made of BPA. For instance, BPA waste is the major reason behind climatic changes and global warming *(Lang and et.al., 2018)*. Further, it is the reason for neurological disorders which are caused in human due to consumption of packaged food or feeding infants with the BPA plastic bottles. *(Ibid)*. Moreover, it analyses the arguments which arise from the success of products containing Bisphenol- A comparison with materials related to the fatal chemical compound Diethylstilboestrol.

The focus of this thesis is on analysing various studies from current research. The discussion centres on the health concerns and impact of Bisphenol-A on humans – aiming at developing critical understanding over the use of products containing BPA properties and assisting in creating awareness among people about increasing concerns of BPA. The thesis starts by outlining the history of using Bisphenol- A across the globe and identifying views of different researchers over worldwide changes and consumption food and liquid stored in BPA. Moreover, the thesis studies history of using Bisphenol- A in EU where it is used the mostly packaging and storing food for a long time, thus leading to contamination which is the major cause of increasing health problems.

Next, the opinions of the EU regarding the hazards of BPA use in products *(Schierow, 2011)* will be outlined as well as the alleged health impacts including adverse impacts on the human body - such as neurological disorders, behavioural changes, heart diseases and reproductive disorders. Furthermore, the thesis focuses on evaluating the reaction of governmental bodies by using Bisphenol-A in the west and EU. It identifies the strategy programs which help increase awareness and reduce the products which are made of BPA to prevent environmental and health problems. And finally, the thesis presents a case study which reflects on the use, problems, impacts and cause of using products made of Bisphenol- A on society.

2 Bisphenol-A

2.1 Origins

Discovered by Russian Chemist, Aleksandr Dianin in 1891, Bisphenol- A or BPA has found many prolific uses due to its non-breakable properties. Being a chemical formula, BPA has no color but is easily dissolvable. As a result, its first main application was in the production of epoxy resins and as an additive to harden polycarbonate plastics.

2.2 Modern usage

Today, BPA is used for making several goods for everyday needs such as water bottles, cans and compact disk. It is also used for the coating on food utensils. For maintaining food safety, it has been tested for years for determining its suitability. Specifically speaking, BPA is used for storage containers to maintain freshness of food and water *(McGrath and et.al., 2017)*. The packaging of plastics has been divided into seven different categories for categories from 1 to 6 are not likely to contain of BPA whereas the category 7 is made with BPA and has a resin identification code 7 which denotes its content and form of plastic (Figure 1).

Figure 1. Recycling codes of different type of plastic. *(the Society of the Plastics Industry, 1988)*

2.3 Health impacts

The compound was further tested by British biochemist Edward from where it was discovered that it is 37000 times less impelling in comparison to estradiol. To contradict the use of BPA, British biochemist Edward launched a similar compound, diethylstilbestrol that is a drug harmful for animals and women. It was banned, as it had major risk of causing cancer whereas BPA was seen as a safer compound and does not relate to any drug and its chemicals *(Calleja and et.al., 2014)*.

According to the survey of the European Food Safety Authority it has been determined that BPA holds no risk which can impact human health and consumers of any age. On the other hand, by the European Chemical Agency, it has been found out that BPA should be listed for limited use as it has contained properties of an endocrine disruptor. The chemical compound has been shown to be very dangerous and leads to various disruption such as cancerous tumors, physical and mental disorders and birth effects *(Alonso-Magdalena and et.al., 2010)*. BPA also hinders the thyroid functioning as it encourages hormones to bind with the thyroid *(Rubin, 2011)*. Furthermore, with the increasing use of BPA it has been determined that environmental chemical and thyroid

functions have caused concern over the uses of BPA. The 2009 test of BPA showed that use of BPA leads to negative impact of thyroid hormones.

In addition to this, the use of BPA leads to neurological disorders, which causes, for example, high level of hyperactivity, tension, anxiety and depression. In accordance to the National institute of health, it has been analyzed that use of BPA substances also impact brain development of infants which effects their behavior since childhood *(Ibid)*. On the other hand, the use of BPA for canned food products and water bottles seems acceptable as it assists the society in maintaining food and drinks safe and fresh for long hours, but due to the long stay in plastic containers food and drinks get contaminated, which leads to negative health effects on health of humans worldwide. Thus, it has been determined that use of BPA has its advantages and disadvantages and The European Food and Safety Association should ban BPA to protect the health interest of people across the globe *(BPA plan ready for new EFSA assessment in 2018 European Food Safety Authority,2017)*.

2.4 Environmental effects

Apart from the impact on human health, the use of BPA is also leading to environmental effects. In 2010, the environment protection Agency of US analyzed that more than one million tons of BPA was found in environment as waste. It impacts environment through its direct use as a chemical in plastics, transportation, staining and coating. Generally, the BPA waste impacts the environment through, for example, irrigation waste, municipal waste water and plastic metal and mineral waste. The waste impacts the quality of water and soil which in turns impacts the evaporation rate.

In addition, the BPA in environment has reduced water solubility which is further impacting many lives in water. According to the (*National Institute of Environmental Health Sciences,* 2017), one aspect for which humans should be concerned about in the use of BPA is negative impacts on health as in 2003 and 2004 the National Health and Nutrition Examination Survey has regulated Centres for Disease Control and Prevention which determined 2517 urine samples in which there was found 93 percent of Bisphenol- A among 6-year-old and older. In accordance to research and analyses, there are various prevention measures, which can assist in controlling adverse impact of Bisphenol- A which are, for example, not microwaving the plastic containers, recycling containers as per their codes, and less use of canned and preserved food items. *(Vandenberg and et.al., 2010)* Thus, BPA is a compound whose use has become necessary but causes various health and environmental problems. Therefore, it is important for the society to understand the limited and effective use of products which contain BPA.

It is important for the people across the globe to focus on recycling plastic products in order to preserve the reserve environment and protect the health of animals and marine life. The increasing waste due to the use of plastic is the major cause which is hampering the stability of climatic condition and giving rise to global warming. With the increasing use, there are adverse effects on more cities where has raised the alarm.

3 Modern use and practices

3.1 General use and controversy

Bisphenol- A is known as building block of polycarbonate plastic. There are many researches on the use and effect of Bisphenol- A worldwide. According to Vogel (2009), Bisphenol A is synthetic chemical which is used in various daily products used by humans. Vogel analysed various adverse health effects such as cancerous tumours, behavioural changes and obesity. The use of BPA has become a headline of the news worldwide as it is related to safety of environment, humans and animals across the globe. However, the waste which has been caused by using BPA and plastics is seen as a possible culprit to major fluctuations in climatic changes and the high temperature and the use of canned food packets impacts health of humans in different ways (Dolinoy, Huang and Jirtle, 2017).

Similarly, the report of U.S. National Toxicology Program (NTP) researched on the issue and analysed that use of plastic material in water bottles of infants affects the brain and behaviour. Further, there are cases where the milk is microwaved at high temperature in the bottle due to which BPA components are seen in the milk of infant (Ibid). As per reviews in Denmark, BPA is completely banned in products which are related to infants. With this ban, the Japanese can industry has replaced the way making products for infants. While in US, there are many states which allow the use of BPA material in bottles but on the other hand, there are 11 states where BPA in products of babies is strictly prohibited (Zhou and et.al., 2014).

Nevertheless, the adverse effects of using BPA are reflected in many controversies worldwide which denote the history of using Bisphenol. Like in 1930, Charles Edward Dodds stated that BPA is an artificial estrogen which is life threatening chemical compound and use of which can lead, for example, to cancerous tumours, behavioural changes and anxiety. There are many researchers which report different facts about BPA, for example, according to Caliendo, (2012), BPA is present in almost all products worldwide and in as well as environment. Chanda and Roy, (2018), in contrast, believes that content and properties of BPA are low in products and are not at all harmful. According to Nordqvist, (2017), it is important for pregnant and feeding women to avoid drinking water from plastic bottles and eating packaged food in order to protect the health of a child.

On the other hand, the use of BPA should be limited as it is associated with many health and environmental problems across the globe i.e. increasing fertility issues especially in men as it, for example, lowers sperm quality and cause heart disease. It has been determined that the using BPA worldwide is adverse like it imitates body hormones which is reflected in secretion, production, body functioning and reduction in natural body hormones. In accordance to uses and worldwide history, it is clear that use of BPA majorly impacts children and the youth population (Vaughn, 2010).

3.2 Re-evaluating BPA use

According to Centres for Disease Control and Prevention (CDC) (Bisphenol A (BPA): Use in Food Contact Application, 2014) components of BPA are found in urine samples of almost all individuals across the globe. The study states that almost all humans make use of products which are made of BPA and this denotes the increasing uses of

harmful substances regardless of their affects (Bisphenol A (BPA): Use in Food Contact Application, 2014). Moreover, as per increasing health problems it is important to create awareness among people about the limit use of BPA products because out of 100 more than 70 percent of individuals are not even aware about the adverse effects which these products are causing to their health. For instance, there are many people who drink water which is stored in water bottles for a long time.

Apart from consumption, BPA can be absorbed to human body through dental sealants (Geens, Goeyens and Covaci, 2011). With increasing the impact of BPA in history, there has been an increased need to spread awareness and general concern about BPA products. People are now focused on checking the labelling to ensure that food packaging is BPA free. Individuals have started buying food which is stored in glass instead of plastics and consuming frozen foods instead of canned. Avoiding microwaving food in plastic containers to prevent contamination is the best practice, which helps the society in reducing effects of Bisphenol- A. Buying wooden toys for infants instead of plastic is another way which has helped the society in managing effects of BPA.

These changes in practices assisted in managing the environmental balance (Rogers, Metz and Yong, 2013). However, still there are many countries that consistently use BPA products which has even increased waste that is hampering the stability of the environment. Thus, the changes in food packaging material and microwave utensils has succeeded in creating awareness among people regarding the negative impact of BPA (Shelby, 2010).

The Food and Drug Administration -FDA's food contact regulations and food contact notification program has assisted in managing changes and making people aware of the harmful effects of Bisphenol- A which, has increased the society participation in managing safe use of material and consumption (Stamati, Hens and Howard, 2013). Apart from infants, the toxicity of BPA products is majorly impacting the reproductive system more strongly than kidney or the liver. It interrupts the whole neuron and hormonal system of human body which is life threatening. There are many cases and controversies which reflect the influence of Bisphenol- A on human, wildlife and environment.

3.3 Using Bisphenol-A in EU

The manufacturing and increasing use of BPA has been a topic of debate as the chemical reaction with its material is impacting health of various vulnerable groups especially infants and youth population across the globe. There are scientific arguments and debates are on the use and manufacturing of products made with Bisphenol- A. To prove the toxic content of Bisphenol- A, the scientists have tested the use of BPA with living organisms which denotes that its major impact is especially on the reproductive system. For 2019, Denmark has been planning to ban use of BPA in order to protect the food and consumed by infants (Background for national legislation on bisphenol A (BPA) in EU and EFTA countries, 2014). In the EU, there are various activities which have taken place to control the impact, use and manufacturing of Bisphenol- A.

Further, the use of BPA in EU has been completely banned with the increasing concern of responsible authorities over human health. According to European chemical Agency (ECHA), (*ibid*) BPA is an organic compound innovated by man, and the concern regarding health and its negative influence is in-creasing due to the endocrine disrupting characteristics. As per researcher, the properties of BPA are concerned with health problems such as hormonal dysfunction, metabolic diseases, thyroid functions and

neurological disorders. Apart from this, it has impacted the reproductive system of the human body by decreasing fertility.

There are various communities and association which have shared their concern regarding use of BPA in food such as French Agency for Food, Environment and Occupational Health and Safety and the European Chemical Agency (Background for national legislation on bisphenol A (BPA) in EU and EFTA countries, 2014). These have outlined the industry use of BPA to make people aware on the health problems when it is used for food packaging that is its Polycarbonate is used for making food containers and feeding bottles for infants.

Furthermore, BPA is also found in cans of beverages like Coca-Cola, Pepsi and in the linings of food which act as a protective coating. It seems very generous when edibles are coated with BPA, but the people are not aware of the harmful impacts of its properties on their health (Chu, 2017). It has become common issue of discussion because the side effects of using packaged food and beverages is the major cause behind increasing disease and health problems which are not temporary but life threatening.

3.4 BPA restrictions in the EU

The EU risk assessment in 2003 which was updated in 2008 with increasing health concerns of the existing chemical program, declared that there is no risk involved with use of BPA, but when was revised, the use of BPA has been banned for packing material and feeding bottles of infants. In addition, to make it stricter, the government and the food regulation association have made it mandatory for the food suppliers and companies to label packaging products that people can analyse the use of BPA properties in the products. This measure was taken by the EU association for establishing control over the use of Bisphenol-A.

To protect human health, approximately 12 states have policies under which use of BPA is banned like, for example, France, it is banned for in containers in Europe, in for baby bottles *(Bisphenol A: EU ban on baby bottles to enter into force tomorrow, 2018)*. The regulation of use of BPA has allowed people to sell product and tools which are made up of BPA, but with exhaustion of six months, the use and manufacturing BPA was again banned Due to these changes in regulations on the use of BPA in the EU, there were several restrictions on the manufacturing of all the products which are related to infants, for example, baby bottle, plastic sippy cups, water bottles and feeding accessories.

Moreover, BPA is banned for pregnant women, they should not use products which contain properties of Bisphenol-A because it directly impacts the health of a child. In addition to food packaging, there are strict limits of the use of BPA, which is focused on minimum impact regarding the health concern for society. The present level allows a Security Market Line (SML) of 0.6 mg of Bisphenol-A in per Kilogram of food *(Whitworth, 2017)*. The EU has planned new patterns of chemical policies; for instances, the European Community of Consumer Cooperatives have shared their views with retailers in Europe over the use of BPA. Like, there are many retailers who do not use products of BPA, these organisations offer their own branded products and with own style and material of packaging which is authorized and is protected by the regulations of the European Union *(Chu, 2017)*.

Figure 2: Labelling for BPA free products (*EU moves to restrict hormone-disrupting chemical found in plastics,* 2017)

The Institute of Food Science and Technology *(EU moves to restrict hormone-disrupting chemical found in plastics, 2017)* has designed a new study on the basis of the evidence which states that use of BPA is strictly prohibited for the products which are produced for infants and in food packaging. In accordance, it is important for the government and food association to create awareness among consumers of the health concerns which are increasing due to use of BPA in regular daily life products.

Moreover, the European Chemicals Agency (ECHA), stood totally for prohibiting Bisphenol-A due to its being an endocrine disruptor. Apart from this, there was 20-year-battle called by Green law group Client Earth against the use of Bisphenol-A *(EU moves to restrict hormone-disrupting chemical found in plastics, 2017)*. Thus, this battle was the reasons behind the rapid changes and the prohibition of BPA content in food packaging and regular products of human lives. In the EU, the fighting for right is easy as European Union regulations are focused on protecting the rights of humans but at the time, the associations discovered major health concerns of BPA such as neurological disorders, thyroid, which are increasing regular and becoming life threatening. However, BPA fall under category of the best seller like in 2006 there were 3.8 tonnes of products produced with Bisphenol-A. This production level denotes its increasing use and demand in market regardless of its side effects on human health. Thus, according to epidemiological studies by German Federal Environment Agency Survey, traces of BPA were found in 591 children out of 599 when tested during survey *(EU moves to restrict hormone-disrupting chemical found in plastics, 2017)*.

4 Alleged health impacts of Bisphenol-A.

Health is the major concern due to which the use and production of BPA has been banned in many states. Like, the major threat of BPA properties is to infants because it is used in baby bottles and sipping cups, BPA impacts the development of child because from an early age, the child faces neurological problems like anxiety and depression. The age of infants is very sensitive; therefore, the use of BPA in baby bottles and products used by pregnant women have been prohibited. There are major health problems which have been increasing due to Bisphenol-A, and it is the reason why the government and food regulation association have been focusing on banning the use of Bisphenol-A in food packaging and water bottles.

According to with Konieczna, Rutkowska and Rachori, (2015), BPA belongs to the field of chemical and is produced in large quantities across the globe. BPA is generally used as polycarbonate and synthesis plasticizer. Further, it is considered as dangerous by scientists and food regulation associations *(Ibid)* because the majority of its use is for the kitchen ware products. The plastic food packaging is the most dangerous use of BPA because it is related to direct consumption and can impact human health directly.

Various researchers have shown that the use of polycarbonate is the growing concern for the society as it a causes various health disease such as neurological disorders, cancers and hormonal dysfunction. Similarly, when it is consumed by a child at growing age, then it impacts pre-development which is the major reason behind increasing early childhood depression and anxiety in youth. BPA plays a crucial role in the pathogenesis of several endocrine disorders such as hormonal tumours infertility among males and females, precocious puberty, breast cancer and disorders like polycystic ovary syndrome (PCOS) *(Report on the Study of Health Impacts of Bisphenol-A (BPA), 2013)*.

Banning BPA products and the manufacture of BPA has become a common and a major concern because it has been increasing health problems for all the people across the globe. Health concern is considered a major problem by the European Union motivating the governments to research about health concerns. With the research, the associations and governments have found that the major cause for immaturity in children and health problems in women is the consumption of packaged and canned food material.

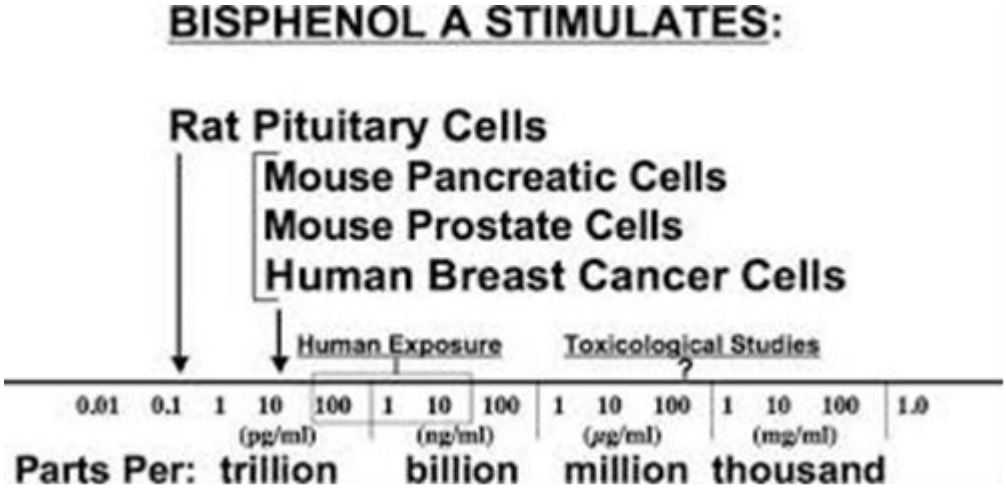

Figure 3: Bisphenol A stimulates *(Wade, Susan and Frederick, 2006)*.

As evidenced by Wade, Susan and Frederick (2006), a billion kilograms per year of the estrogenic monomer bisphenol A is used for making products of plastic every year which demonstrates an excessive use of poly carbonate products in daily lives of humans. The BPA products are related to plasma membrane, and; therefore, they cause changes to cell functions. To measure BPA, the associations and researchers implements the use of various techniques such as fetal, adult and pregnant maternal, blood samples and regulating a check over changes in tissues and hormones. Further, anxiety and depression is another clear factor which denotes the consequences of BPA due to consumption and which is considered as neurological disorder *(Trosko and Upham, 2010)*.

The consumption of Bisphenol A by human heads to weakening of the estrogen activity. Almost 95 percent of individuals across the globe have level of BPA in their urine samples. Further, it has been found in amniotic fluid, breast milk, cord blood, placenta, neonatal blood and breast milk *(Barraza, 2013)*. Apart from this, almost all organic and non-organic food contains BPA and which is a man-made disruptor. Therefore, controlling the use of BPA has become important to create awareness among people of the health problems related to and increasing due to the use of bisphenol-A *(Lofstedt, 2013).*

However, the use of Bisphenol- A is a leading concern not only for humans but also for animals for example the consumption of BPA in humans is the cause for type 2 diabetes, metabolic syndrome and increasing body mass index and obesity. On the other hand, animal consumption of BPA is related to various diseases such as glucose intolerance, Beta cell dysfunction, altered insulin secretion, high glucose in blood, insulin resistance, increasing body weight, increasing fat cells and type 1 diabetes and in mice gestational diabetes *(Barraza, 2013)*. Thus, avoiding BPA has become a common discussion because the health concerns are increasing with the increasing use of BPA.

Using products which are made with BPA leads to anxiety and mood swings and impact brain development. The study of researchers from Duke university *(Ibid)* found that BPA impairs the development of the central nervous system which disrupts nerve function. It is very common in rats, humans and mice. Further, the study of researchers, studied, BPA sampled from animal injection and showed that in rats, the BPA content has increased health problems due to their direct food consumption.

Further, in a study over diabetes and obesity, it has been reported that according to examination of National Health and Nutrition Examination Survey (NHANES) of 2003 and 2008, 3515 people have BPA in their blood and it is the reason behind cause of their diabetes *(Report on the Study of Health Impacts of Bisphenol-A (BPA), 2013)*. Moreover, with respect to glucose levels and diabetes in humans, it has been identified by researchers that there are 34 percent increases in glucose level in the diabetic condition in comparison to the fasting levels of glucose. Thus, from evaluation, it has been evaluated that production, use and consumption of Bisphenol-A worldwide is the major cause behind increasing health concerns and it is leading to various life-threatening problems which are never ending *(Bloch, 2011)*.

In accordance, it is important for the government to ban the use of BPA in all states across the globe and to create awareness in society about the hazardous health impacts which arise due to use of products which are made with Poly carbonate. Hence, in accordance to *Concerns related to ED-mediated effects of Bisphenol A and their regulatory consideration (*2018), it has been analyzed that increasing use of Bisphenol-A is impacting health and leading to various incurable diseases for example reproductive disorders, metabolism functioning, changes in neurological behavior which are the

main cause of increasing early signs of anxiety, depression, development. The hormonal changes in individuals are the major factor which is related to growth and development and therefore it is important for the people to be aware of Bisphenol-A and its alleged health impacts.

For determining BPA exposure in humans, the Center for Disease Control has consulted a survey in 2005, where it was found that 95% of urine samples collected from 394 Americans adults have properties of BPA. In this study, there was another study which was focused on exposing level of BPA in children in which scholar had researched 9 children in day care where studied it was analyzed that the exposure level of BPA in nine children was 42.98 ng/kg/day. Further, to for immaturity in children and health problems in women is, one more research which was focused on 257 children of preschool was considered, and Bisphenol was detected in 50 percent indoor air of school on the other hand, 99% of exposure in children was due to diet, which was 52-74 ng/kg/day.

4.1 Regulations with Bisphenol-A.

Accordingly, there have been various causes and effects from the use of Bisphenol-A in products such as cans, food packaging and water bottles. In response, many countries have focused on surveying the health concerns which are increased with the use BPA, with the help of the food association. To prohibit and make limit the use of BPA, the governing bodies have planned various initiatives which are focused on highlighting precaution regarding use of Bisphenol-A. The initial step to control and limit the use of BPA in daily life products of society, mandatory labelling and classifications are required from every organisation producing or selling products with BPA. The classification and labelling of BPA is mandatory under index number 604-030-00-0.

Further, to make classification and labelling more harmonised and to strengthen the committee for risk assessment has adopted a new timeline for labelling in which BPA was moved from a category 2 reproductive toxic to a category 1B generative substance. This increased concern was demonstrated with the estimated consumption of BPA in the Netherlands which has been continuously increasing from 1996 to 2000. The consumption of Bisphenol-A in daily lives products was recorded 9600 tonnes in 1996 and with continuous increase it reached 14000 tonnes which clearly reflects increasing health problems. Apart from health problems, government is concerned with Bisphenol-A worldwide and specifically to EU because of increasing concern to waste disposal. Similarly, the waste of polycarbonate and epoxy resin is increasing due to consumer goods.

On its part, the EU is focused on strengthening regulations for Bisphenol-A, in food contact plastics and in coated products such as canned food packets and beverages (*EU Strengthens BPA Restrictions in Food Contact Materials and Articles,* 2018). To determine the limit for the use of BPA in products, the government has strengthened the system in which the limit is for BPA was dropped 0.6 mg/kg to 0.05 mg/kg in food contact plastics whereas in coated food. (*New EU Regulation Sets BPA Limit in Food-Contact Varnishes and Coatings and Reduces Limit for BPA in Food-Contact Plastic Materials and Articles,* 2018).

Further, as per changing regulations with regards to the use of BPA use of poly carbonate in feeding bottle of infants is still prohibited, and it will never change because the consumption of Bisphenol A by infant is the most dangerous problem as it hampers the development of a child at the initial stage. The food regulation authorities and governments have been supporting safety of the products which are made of BPA. Furthermore, the use of BPA has become authorized, and it is important for the manufacturers and suppliers to seek permission for selling products which contains properties of Bisphenol-A. The European Union regulation 10/2011, BPA has a specific migration limit which is of 0.6 mg/kg and as per EU 321/211 feeding infants from plastic bottles have been banned because it was the major concern which has been impacting development of child brain in early growth phase of life. Nevertheless, in 2002, opinion on the issue of food was determined by European Commission Scientific Committee for Bisphenol-A which as first set a limit at 0.01mg /kg body weight/day wherein 2006 it has been increased to 0.05 mg/kg body weight/day and further after several years it was decreased from 0.05 to 0.005 mg/kg body weight/day (*Dossier – Bisphenol A*, 2014).

According to governments and food authorities, it is important to create awareness among society about the harmful impact of BPA, because there are several people who are not even aware about the causes and side effects which are increasing due to consumption of BPA unknowingly. It has become essential for the EU to formulate strict policies and regulations to ban and prohibit the use of Bisphenol-A. To prevent the use of products which has properties of BPA the government has banned the use of BPA. The increasing adverse impacts on health due to the use of BPA products include a rise in the levels of unilateral or bilateral blood filled ovarian bursa which reflects the concern on BPA. To control the use of products which contain properties of BPA, the food association authorities are focused on controlling food preservation technologies.

To stop using BPA chemical in plastic and resin manufacturing as well as BPA in the plastic utensils, various governments have rules and regulations in against BPA. It includes the toxic elements which creates life threatening diseases to individuals. Moreover, the use of such chemical in manufacturing must be stopped. Thus, in relation to this serious issue, various governments have made ethical regulations on which the EU is also aiming at. The EU food law has proposed to make necessary efforts to stop the consumption of such toxic chemicals in the production or designing any article. The EU ensures protection of human health in its territory.

In accordance with The French restriction from the article 18(1) of regulation (EC) no. 1935/2004 states that the use of such chemical or material has endangered the human life. There has been huge debated and arguments over it because many of the industries treated as unfair to them as BPA was cost efficient. Thus, in accordance with the ANSES the French agency for food, environmental and occupational health and safety act, has demonstrated that they will suspend the use of such material in manufacturing, packaging as well as in importing and exporting. It is because the BPA has direct connection with the food and which cause higher damages to the society at large. On the

other side, it has been argued by EFSA (European Food Safety Authority) that Bisphenol A does not poses any health risks to the individual as the chemical exposure to the food is very low and will not harm any human being. Therefore, here the court was requested to review or research the chemical to restrict the use of such material.

However, several articles discovered that major issues are considered as well as acknowledges by various governmental agencies throughout the globe. They have made various changes which will be helpful for them in overcoming such issues. Similarly, EU has made various regulation and changes against the chemical uses in the manufacture and production of products with this toxic chemical. However, the European Commission has presented a lower specific migration limit which was applicable in the chemical use (*Analysis: French action on Bisphenol A and the EU response*, 2017). The SML executes the use of various chemicals in coatings and plastics of any food container product which must be in between 0.06 mg/kg to 0.05 mg/ kg. Thus, it will be helpful in reducing the toxic influences in the food consumed by the consumers.

Moreover, the government has proposed various changes and made changes in relation to restricting such chemical in the production of food containers of the products which has direct contact with food. Here, the European commission has aimed at introducing various alternatives to resolve such issues. They have set limits over the use of such chemicals as well as proposed restrictions over it. Thus, it is mandatory that the government must implied the principles and ban the use of BPA in unequal terms.

5 Case study

In this case study which was demonstrated by Andrew Benson's study in (2014), the individual focused on explaining each and every part with pinch of detail in order to make people aware of the use of products which containing properties of Bisphenol-A. It is a chemical which is specifically used in polycarbonate plastic for the products for such as water bottles, canned beverages, food items which are preserved for fresh consumption. However, society is not aware of its uses and side effects, for example, of the fact that food packed in material coated with Bisphenol-A may be exposed to the adverse properties of Bisphenol-A which are dangerous and life threatening for human health. It seems good to society that food remains preserved and fresh in coated packaging, but people are not aware of the threats which it is causing to human life.

In addition, it has been determined that Bisphenol-A is a synthetic estrogen which was enhanced in 1891, and developed to concern issue of women which arise at time of menstruation and nausea at time of pregnancy. However, in 1990 researchers have discovered its use in plastic products and packaged food despite of its side effects. In this, the individual focused on the people who gets affected with use of Bisphenol-A. As per this, almost all the people get affected with its impact like manufacturers who involves in process of coating and packaging, consumers who are the final buyers related to purchase of products, producers of food which contains therein and health association and authorities who seeks for public safety. Further, with the increasing side effects, WU has completely banned the use of BPA in baby feeding bottles. The French

National Assembly voted to prohibit use of BPA in packaging for food materials and beverages.

Apparently, the case study on Bisphenol-A which is analysed with the help of testing and analysis where the problem was the supplier of consumer product wanted to determine BPA in final products; that is lids, storage bags and polymer containers for which the researcher determined solution by implementing proper techniques like Gas Chromatography Mass Spectrometry (GC-MS). With the testing, it has determined that products containing BPA leads to adverse impact on the reproductive system of human body, and therefore, it is important for the manufacturers to produce BPA free products due to increasing concern of consumers. GC-MS analysis is the best technique that helps in determining properties of Bisphenol-A in sample of product.

Further, with the test of lids, storage bags and containers, it has been demonstrated that no BPA is present in any of the sample *(Case Study: Bisphenol-A (BPA) Testing and Analysis, 2008)*. The use of BPA has been prohibited and limited by the government due to the increasing health concerns. Many food authorities and associations have made it compulsory for the manufacturers and suppliers to classify and label BPA free products because according to these authorities, it is important for the society to understand the problems increasing with consumption packaged food and beverages.

According to the case study the majority of US people have been exposed to the high production of Bisphenol-A. In this case a mother who is an African-American woman and is 26 years old, has no medical history *(Case Report: High Prenatal Bisphenol an Exposure and Infant Neonatal Neurobehavior, 2011)*. In HOME which is Health Outcomes and Measures of the Environment she investigated prenatal and postnatal toxicant environment in child health in which it was determined BPA concentration in urine sample which was 583 µg/g during 27 weeks of pregnancy which was maximum and was the highest. Further, an interview survey was conducted to analyse potential and use of plastics and consumption of canned food and beverages. In this it was analysed that new-born child had abnormalities.

With the increasing health hazards determining the health impact on humans has become necessary. Further, in this case study blood was evaluated of 100 individuals by dividing them into groups *(Evaluation of blood bisphenol A contents: a case study, 2012)*. The investigator grouped 100 people in five groups according to their age that is from 5-10, 11-20, 21-30, 31-40 and 41-50 years. Moreover, the researcher divided them according to their drinking sources, age, gender, and eating ad smoking habits. Blood samples of each one was collected from which it was determined that individuals who are suffering from cancer and significant relationship with BPA, and there is link of their cancer and BPA. Hence, from this case study it has been determined that person consumption of canned food and beverages leads to the chance of cancer and many other diseases which can be high blood pressure, increasing heart rate.

6 Conclusion

The report summarized the concept of Bisphenol- A is organic synthetic solid compound. It is used for making plastic products, compact disk and for storing canned food and beverages. It has been found out that packaging of plastics has been categorised into seven different categories where 7th category is BPA. The existence of BPA has

been argued by various researchers and scientists because it relates to many poisonous substances which are not but human use. Further, it has been analysed that government should limit the use of BPA as it has content and properties of endocrine disruptor, which is a chemical compound that leads to disruption such as cancerous tumours and neurological disorder. In this report argument of various authors have been recorded from which it has been analysed that use of BPA is hampering the environment as the release of plastic waste is hampering atmosphere as rate of vaporisation has decrease.

However, from the history of using Bisphenol-A it has been evaluated that BPA is a headline of news across the globe as it is related to the safety of the environment, humans and animals worldwide. In addition, it has been identified that the initial bans of Bisphenol-A were on baby bottles of infants because researchers and scientists found that it is the major cause of behavioural changes in child growth and development. Besides, they have reported on increasing health problems with the use of products made of BPA, for example, increasing fertility issues especially in men, which may lead to lower sperm quality.

On the other hand, from the report it has been derived that BPA enters human body not only through consumption but through using dental sealants or working at construction sites. The containers, which is used to keep the liquid at high temperature for a long time at contrition sites, can release the BPA to environments and the workers incidentally absorb it. And with the use of harsh washing powder to wash the containers based BPA can also release BPA to the environments. Increasing of products with BPA properties are the reason behind increasing health problem; therefore, it has become important to create awareness in society of the limiting the use of BPA products because as per the report out of 100 more than 70 percent of individuals are not aware about the health problems which are related to the consumption of canned food and beverages *(Analysis: French action on Bisphenol A and the EU response, 2017)*.

As for the increasing awareness of health concerns with the use of BPA, the European Union has banned the use of BPA-based materials for packing of food material and for the manufacture of feeding bottles of infants. Further, members of chemical policies have enforced new structure of chemical policies for as the European Community of Consumer Cooperatives have shared their mutual views over retailers in Europe use of BPA in their products. From this, it has been determined that retailers now have their branded products and have been focusing in labelling and classification of products. The report outlined that chemical which are found in kettles, water bottles, C compact disks are strictly banned by the European Union, because the government believes, it is an issue of human health and leads to hormone dysfunctions *(Bisphenol A: EU ban on baby bottles to enter into force tomorrow, 2018)*. Apparently, as for the alleged health impacts of Bisphenol-A, it has been recognised that young infants are very sensitive when it comes to brain development; furthermore, the use of BPA in baby bottles has been disallowed. It has also been reported that the consumption of BPA increases the chance of diabetes and affects glucose metabolism, but the effect of BPA is more prominent in the development of diabetes than in the changes glucose metabolism. Thus, the report concluded with governmental regulations which are enforced by EU to prohibit the use of BPA in all products. Hence, it outlined various case studies which summarized their own outcomes with respect to the impact of using BPA based products, for example, cancerous diseases and brain development problems.

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Appendix 1: plastic recycling types *(KS environment, 2013)*

Symbol	Description	
1 PETE	Clear tough plastic such as soft drink, juice and water bottles.	
2 HDPE	Common white or coloured plastic such as milk containers and shampoo bottles.	
3 V	Hard rigid clear plastic such as cordial bottles.	
4 LDPE	Soft flexible plastic e.g. squeezable bottles such as sauce bottles.	
5 PP	Hard but flexible plastic such as microwave ware, takeaway containers, some yoghurt/ ice cream/jam containers, hinged lunch boxes.	
6 PS	Rigid, brittle plastic such as small tubs and margarine/butter containers.	
7 OTHER	All other plastics, including acrylic and nylon. Examples include some sports drink bottles, sunglasses, large water cooler bottles.	

Please note: this is an indication only of what type of products might fall in the 1-7 categories. This can differ amongst brands so please check the item first to ensure it can be recycled.